



IMS Disaster Recovery Solutions

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IBM Advanced Technical Skills (ATS)

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Agenda



- Disaster Recovery for IMS Base
 - Restoring databases to earlier image copies
 - Restoring databases using Full Database Recovery
- Disaster Recovery with IBM IMS Tools Products
 - Timestamp Recovery to a Recovery Point
 - RP is created without taking databases offline
 - Uses IMS V11 DB QUIESCE
 - Demonstration of IBM IMS Tools DR Strategy
 - Uses IBM IMS Tools Packages (6 Products)

With the base IMS product, we will explore disaster recovery where the remote site is restored to a specific recovery point using batch image copies and a backup of the DBRC RECON data set. There are no logs sent to the remote site so there is no forward or backward recovery of the database. With this solution, the updates made after the image copies were taken is lost at the remote site.

In the second method, batch or concurrent image copies are sent to the remote site along with a backup of the DBRC RECON data set. Additionally, the user also sends the log data sets which allows the remote site to do forward and backward recoveries of the data. This means there is less data lost in the event of a disaster. With this solution, full database recovery is used at the remote site which applies all of the updates from the logs including any uncommitted updates at the end of the log. During Emergency Restart, the uncommitted updates are dynamically backed out.

The third method discussed uses the new IMS Tools Packs (IMS Recovery Pack, IMS Base Pack, IMS Database Pack). The tools used are: 1) IMS DRF, 2) IMS HP Image Copy, 3) IMS HP Pointer Checker, 4) IMS Index Builder, 5) IMS DRF XF, and 6) IMS Tools Knowledge Base. With this solution, recovery points are created using the IMS V11 DB QUIESCE function and batch incremental image copies are created to the recovery point. The DBRC RECON data set is cleaned up to the recovery point. At the remote site, the databases are restored using only the batch incremental image copies.

Two Approaches to IMS Disaster Recovery



- Approach 1
 - Ship Image Copies, Logs, RECON to Remote Site
 - Manually clean the RECON data set
 - Prepare resources for recovery and restart
 - *“Typical remote site recovery of the past”*
- Approach 2
 - Drive the remote site recovery using IBM IMS Tools
 - Remove the manual RECON cleanup operations
 - Create recovery points without impacting workloads
 - Reduce the time of the recovery at the remote site

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3

There are many disaster recovery strategies. In this presentation, I will cover three common ones: two for the base IMS product and one using IBM IMS Tools products. The first is to recover the database data sets to image copies and disregard any updates that occurred after the image copies were taken. The RECON data set is backed up and shipped with the image copies to the remote site. The RTO which is the time taken to recover databases at the remote site is lower than strategies that involve restoring databases with changes on the log data sets. The RPO is higher than those strategies because updates to the databases following when the image copies were taken are not recovered at the remote site.

The second disaster recovery strategy using the base IMS product involves full database recovery using image copies and the last good log data set shipped to the remote site. The RECON data set is shipped with each archived log data set. The RTO is higher with than the first strategy because updates from the logs are applied to the image copies to restore the database data sets. However, RPO is lower than the first strategy because the updates on the logs that occurred after the image copies were taken are not lost.



Concepts

- Disaster Recovery
 - Process of recovering a Production environment
 - Restore to point where business can be conducted
- Recovery Time Objective (RTO)
 - Time allowed to recover the applications
 - All critical operations are up and running again
- Recovery Point Objective (RPO)
 - Amount of data lost in the disaster
 - Last point-in-time when all data was current

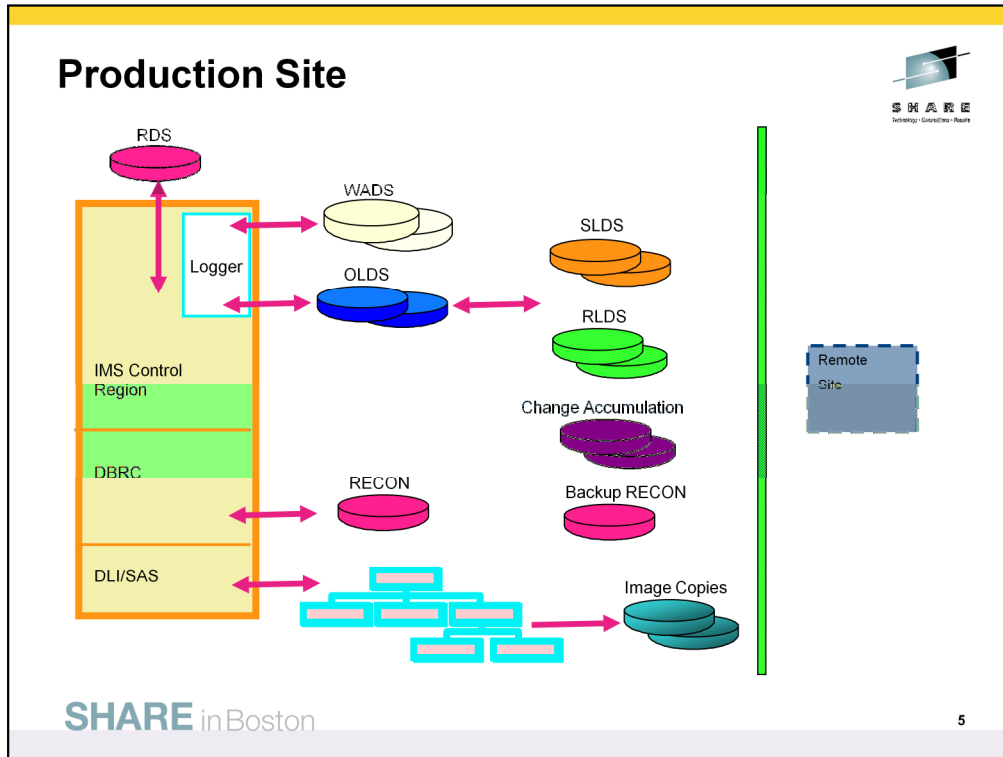
Disaster Recovery is the ability to restart a production environment in a remote site following a disaster that makes the primary site unusable. Customers must determine the amount of time and the amount of data they can afford to lose when they are setting their recovery goals.

The Recovery Time Objective (RTO) is the amount of time it takes to bring up the production system in the remote site. The Recovery Point Objective (RPO) is the amount of data that can be lost in such a disaster. Typically, most institutions with critical systems on mainframe computers have a RTO of under two hours. By comparison, most UNIX environments with less critical systems have an RTO of under eight hours. The RTO and RPO objectives need to be determined on an Application-by-Application basis.

The cost of the disaster recovery solution needs to be in proportion to the business value of IT. In other words, the disaster recovery solution should not cost more than the financial loss suffered from the disaster itself.

The amount of data mirrored to a remote site and the currency of the data will greatly affect both the RTO and RPO of the remote site. If the production system can simply be emergency restarted from a recent checkpoint, there will be less data lost (RPO) and the restart will take less time (RTO). The amount of time increases dramatically for IMS when the system needs to recovery data from older image copies. In disaster recovery terms, it is always better to do a Restart than a Recovery.

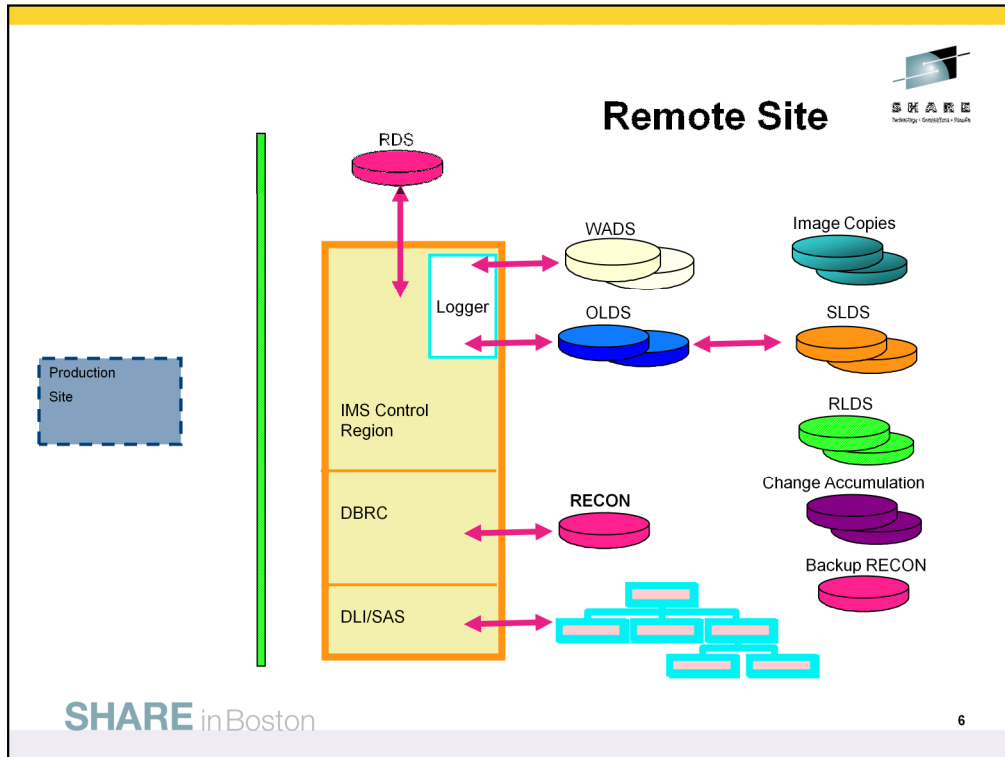
Once the RTO and RPO objectives are known, the customer is able to determine which disaster recovery methodology works best for their needs.



IMS uses log data sets to record database activity. The logs contain before and after images of the data. For this reason, IMS is able to recover data in failure and disaster recovery situations.

The online IMS system writes Online Log Data Sets (OLDS) while IMS Batch jobs create System Log Data Sets (SLDS). When the OLDS becomes full, IMS switches from one OLDS to another OLDS. An archive of the OLDS data set is required to move the OLDS data into an SLDS data set. This frees up the OLDS data set so that it can be used again. DBRC is automatically notified when a new OLDS data set is being used.

IMS writes system checkpoint information to the Restart Data Set (RDS). During each checkpoint, IMS creates or updates a checkpoint ID table; IMS uses this table during IMS restart to determine from which checkpoint to restart the system. If, for any reason, the RDS is not available at restart, IMS can obtain the required checkpoint information from the log. While the use of the log to recover this checkpoint information may lengthen the restart process, it does mean that the RDS is not required to be sent to the remote site.



Prior to the restart of the remote IMS systems, the only data sets at the remote site are those that will be used for recovering the database data sets. This means there will either be just image copies and the backup DBRC RECON data set or there will be a combination of log data sets that may also include the RLDS and Change Accumulation data sets. The WADS and OLDS from the Production site will not be at the remote, nor will the RDS be at the remote site.



Approach 1: Typical DR with IMS Base

- Strategy 1: Recover databases to Image Copies Only
 - Ship Image Copies + RECON to Remote Site
 - RTO: Databases are restored from image copies only
 - RPO: Updates after image copies are lost
- Strategy 2: Full Database Recovery to Last Good Log
 - Ship Image Copies + Logs + RECON to Remote Site
 - RTO: Log updates are applied to image copies
 - RPO: Less data loss since updates are applied and backed out
 - Note:
 - Full Database Recovery is for non-datasharing environments

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The second disaster recovery strategy using the base IMS product involves full database recovery using image copies and the last good log data set shipped to the remote site. The RECON data set is shipped with each archived log data set. The RTO is higher with than the first strategy because updates from the logs are applied to the image copies to restore the database data sets. However, RPO is lower than the first strategy because the updates on the logs that occurred after the image copies were taken are not lost. Full Database Recovery does not work in a datasharing environment since there could be “spill” records with

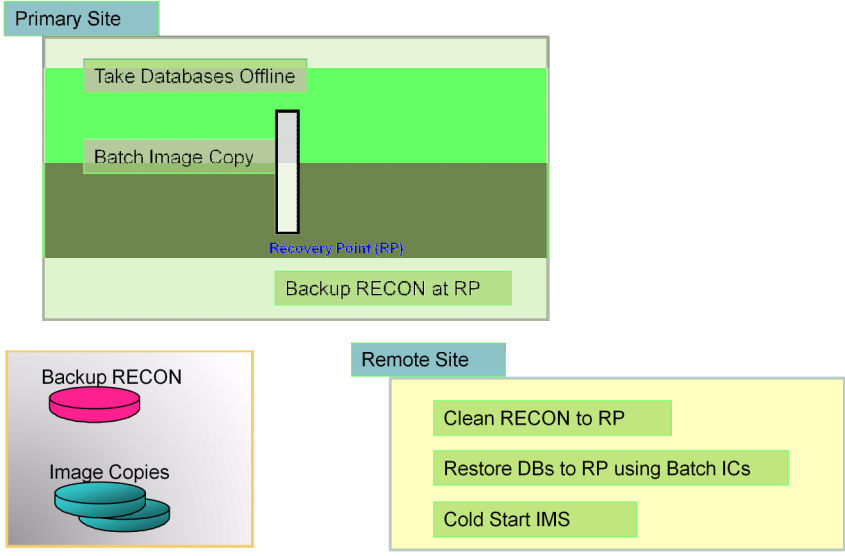
Approach 2: Enhanced DR with IBM IMS Tools

- Strategy 1: Timestamp Recovery to a RP
 - Ship Batch Incremental ICs + Cleaned RECON to Remote Site
 - RTO:DBs are restored from batch Incremental image copies
 - RPO:Less data loss since ICs include log updates to RP
 - IBM IMS Tools Used:
 - IMS Database Recovery Facility.....(5655-N47)
 - IMS Recovery Expert.....(5655-R26)
 - IMS High Performance Image Copy.....(5655-N45)
 - IMS Index Builder(5655-E24)
 - IMS High Performance Pointer Checker.....(5655-K53)
 - IMS Tools Knowledge Base.....(5655-R34)

The disaster recovery strategy involving the IBM IMS Tools products uses Timestamp Recovery to a recovery point generated by the IMS Recovery Expert product. With this solution, batch image copies are taken using High Performance Image Copy at the primary site and later updated using the Database Recovery Facility Incremental Image Copy process. The IMS Recovery Expert tool cleans the RECON data set and prepares it for use at the remote site. The High Performance Pointer Checker tool is used each time an image copy is created or a database is recovered. Finally, the Index Builder tool is used to rebuild both Full Function and HALDB primary and secondary indexes. Reports from all of these tools are deposited in the IMS Tools Knowledge Base repository.

With this strategy, RTO is higher than just restoring image copies, but it is lower than strategies that require applying log updates to image copies, because Incremental Image Copies are created at the primary site while IMS is still active and these produce Batch image copies reducing the amount of updates needed from the log data sets. RPO is lower than the strategy restoring only image copies because updates are applied to the databases after the image copies were created.

Recover DBs to Earlier Image Copies



This disaster recovery plan uses the base IMS product. Batch image copies are created when the databases are unavailable along with backups of the DBRC RECON data sets. These data sets are sent to the remote site. At the remote site, the backup RECON needs to be cleaned before it can be used to restore the database data sets with the batch image copies. A cold start is used to bring IMS back up at the remote site.



Recover DBs to Earlier Image Copy

- Primary: Prepare the Remote Site
 - Quiesce the IMS environment
 - Take Batch Image Copies periodically and Backup RECON
 - Ship Image Copies + RECON to Remote Site

- Remote: Clean Backup RECON
 - Delete Active Subsystems
 - Use LIST.SUBSYS to show active subsystems
 1. *CHANGE.SUBSYS SSID(ssidname) ABNORMAL*
 2. *CHANGE.SUBSYS SSID(ssidname) STARTRCV*
 3. *CHANGE.SUBSYS SSID(ssidname) ENDRECOV*
 4. *DELETE.SUBSYS SSID(ssidname)*

At the Primary Site, the user periodically creates Batch image copies and backup copies of the DBRC RECON data set. These data sets are sent to the Remote Site.

At the Remote Site, the Backup Recon data set must be cleaned before it can be used for recovery. The first step is to delete any active subsystems. When the subsystems are deleted, it is necessary to Cold Start the IMS subsystem. A LIST.SUBSYS command will show if there are active subsystems and there are several DBRC commands that allow these to be deleted. They are:

1. *CHANGE.SUBSYS SSID(ssidname) ABNORMAL*
2. *CHANGE.SUBSYS SSID(ssidname) STARTRCV*
3. *CHANGE.SUBSYS SSID(ssidname) ENDRECOV*
4. *DELETE.SUBSYS SSID(ssidname)*



Recover DBs to Earlier Image Copy

- Remote: Clean Backup Recon (continued)
 - Secondary Image Copies
 - Flag the Primary Image Copy in the Recon as Invalid
 - Fastpath DEDBs
 - Flag DEDBs AREAs as Recovery Needed to enable recoveries
 - Use Clean Recon with GENJCL.RECOV JCL
 - Recover databases using Image Copies with either:
 - *Standard IMS Recovery Utility (DFSURDB0)*
 - *IMS Database Recovery Facility (DRF)*
 - Cold Start IMS Systems
 - Databases are consistent with Earlier Image Copy

The second step is to determine if dual image copies were created at the primary site. With dual image copies, the user must determine if the secondary or primary image copies were sent to the remote site. If they are secondary image copies, then the primary image copies must be flagged as invalid. The command to do this is:

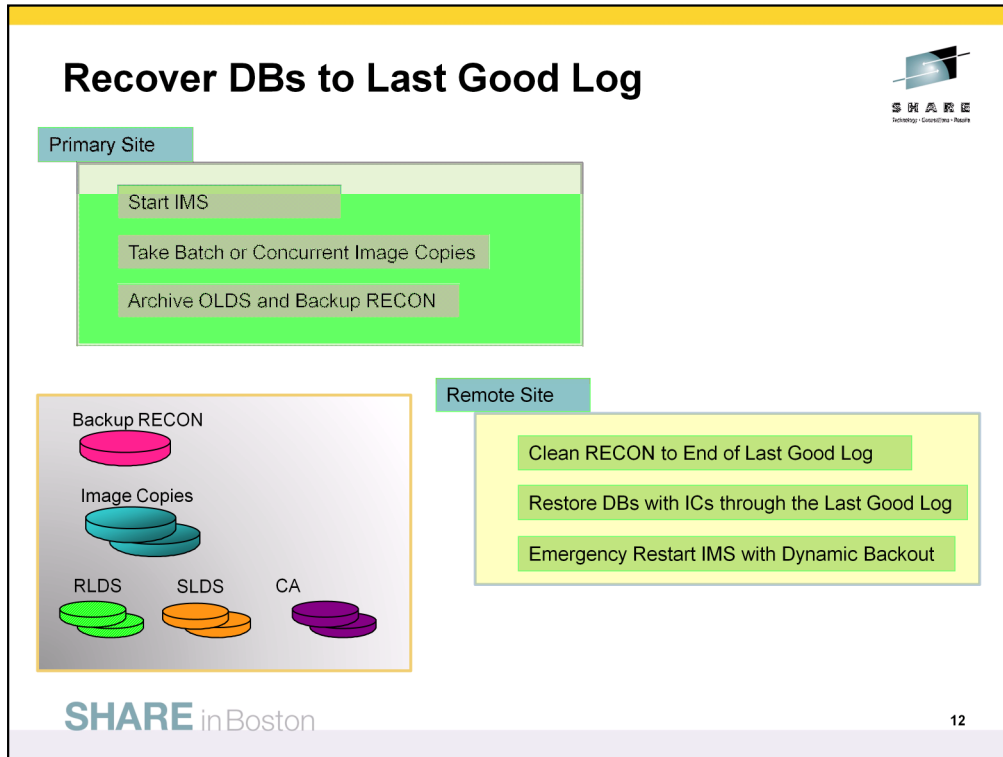
```
CHANGE.IC DBD(dbname) DDN(ddname) INVALID
```

The next step is to flag any DEDB AREAs that may exist as “Recovery Needed” so that they can be recovered by the recovery tools. The command for this is:

```
CHANGE.DBDS DBD(dedbname) AREA(areaname) RECOV
```

Once the Backup RECON data set has been cleaned, it can be used with GENJCL.RECOV to create the recovery JCL. The recovery JCL will use only image copies and they can be restored with either the standard IMS Recovery Utility (DFSURDB0) or the IMS Database Recovery Facility (DRF) utility.

After the database data sets have been restored, IMS can be Cold Started.



This disaster recovery plan uses the base IMS product. Batch or concurrent image copies are created when the databases are unavailable or available. Each time an OLDS is archived, a backup of the DBRC RECON data set is created. The image copies, backup RECON, and archived log data sets are sent to the remote site. At the remote site, the backup RECON needs to be cleaned before it can be used to restore the database data sets with the batch image copies and log data sets.

In this scenario, full database recovery is used with all of the available log data sets. Since there could be uncommitted updates on the logs that are applied to the database data sets during full database recovery, an Emergency Restart is required to dynamically backout the uncommitted updates. There are no OLDS data sets at the remote site so IMS will dynamically allocate the last two SLDS data sets for the restart.



Recover DBs to Last Good Log

- Primary: Prepare the Remote Site
 - Take Batch or Concurrent Image Copies
 - Optionally consolidate changes with Change Accumulations
 - Ship ICs + Recon + SLDS/RLDS + CAs to Remote Site
- Remote: Clean Backup Recon
 - Close and Archive INUSE OLDS
 - No Databases can be Allocated on an OPEN log
 - *OLDS are not sent to Remote Site*
 - All PRILOG, PRISLD, PRIOLD need non-zero Stop Times

At the Primary Site, the user periodically creates Batch or Concurrent image copies and also creates backup copies of the DBRC RECON data set when the image copies are created and when the OLDS are archived. These data sets are shipped along with archived SLDS or RLDS data sets and optionally with Change Accumulation data sets to the remote site.

At the remote site, the Backup RECON data set needs to be cleaned for use with full database recovery. There can be no databases allocated on an open log data set. The OLDS data sets are not available at the remote site. When the OLDS are still open, the PRILOG, PRISLD and PRIOLD records in the RECON data set have valid Start times, but their Stop times are all zeros. When the OLDS are closed and archived, the Stop Times are set to non-zero values. The Log Recovery Utility (DFSULTR0) will not put the non-zero Stop times into these three records because it is expecting an Archive to be run.

A method that will put non-zero stop times into these DBRC records is to identify the active OLDS data set in the RECON data set. This can be done with the following DBRC command:

```
%SELECT OLDS INUSE
```

This OLDS data set (ex. DFSOLP01) should be closed and flagged as ARCHIVE NEEDED. This is done by:

```
NOTIFY.PRILOG OLDS(oldsd) SSID(newssid) -  
STARTIME(start) ... RUNTIME(start+1)
```

Prior to running the Archive utility, an empty OLDS data set is allocated. When the Archive utility is run, it finds the OLDS data set is empty and it puts non-zero Stop times in the PRILOG, PRISLD and PRIOLD records.



Recover DBs to Last Good Log

- Remote: Clean Backup Recon (continued)
 - Delete Active Subsystems
 - Use LIST.SUBSYS to show active subsystems
 1. *CHANGE.SUBSYS SSID(ssidname) ABNORMAL*
 2. *CHANGE.SUBSYS SSID(ssidname) STARTRCV*
 3. *CHANGE.SUBSYS SSID(ssidname) ENDRECOV*
 4. *DELETE.SUBSYS SSID(ssidname)*
 - Secondary Image Copies
 - Flag the Primary Image Copy in the Recon as Invalid
 - Fastpath DEDBs
 - Flag DEDBs AREAs as Recovery Needed to enable recoveries

The next step in the DBRC RECON cleanup process is to delete any active subsystems. The DBRC command LIST.SUBSYS shows if there are active subsystems and there are several DBRC commands required to delete them:

1. *CHANGE.SUBSYS SSID(ssidname) ABNORMAL*
2. *CHANGE.SUBSYS SSID(ssidname) STARTRCV*
3. *CHANGE.SUBSYS SSID(ssidname) ENDRECOV*
4. *DELETE.SUBSYS SSID(ssidname)*

If the Image Copies at the remote site are secondary image copies and not the primary image copies, then you have to flag the primary image copy as INVALID. The command to do this is:

```
CHANGE.IC DBD(dbname) DDN(ddname) INVALID
```

The next step is to flag any DEDB AREAs as Recovery Needed so that they can be recovered by the recovery tools. The command for this is:

```
CHANGE.DBDS DBD(dedbname) AREA(areaname) RECOV
```



Recover DBs to Last Good Log

- Remote: Clean Backup Recon (continued)
 - Change Accumulation data sets:
 - If shipped to remote site:
 - *Ensure RECON is pointing to correct CA data set name*
 - *CHANGE.CA CADSN(*caname*)*
 - If used at primary site, but not sent to remote site
 - *Ensure RECON shows CA data sets are INVALID*
 - *CHANGE.CA CADSN(*caname*) INVALID*

The next step in cleaning the DBRC RECON data set at the remote site is to determine if the primary site was using Change Accumulation (CA) data sets and if these data sets were sent to the remote site. If there are CA data sets in the Backup RECON data set, they will need to be changed to point at the copy of the CA data set at the remote site. The DBRC command to do this is:

```
CHANGE.CA CADSN(cacopydatasetname)
```

Alternatively, the CA data sets in the RECON data set can be flagged as INVALID, in which case, DBRC will not use the CA data sets for recovery and it will only use the available log data sets. The DBRC command to invalidate a CA data set is:

```
CHANGE.CA CADSN(datasetname) INVALID
```



Recover DBs to Last Good Log

- Remote: Clean Backup Recon (continued)
 - Use Clean Recon with GENJCL.RECOV JCL
 - Recover databases with ICs + CAs + SLDS/RLDS with either:
 - *Standard IMS Recovery Utility (DFSURDB0)*

Once the Backup RECON data set has had some initial cleaning, it can be used to create the recovery JCL using the DBRC command GENJCL.RECOV. The recovery JCL will include the image copies and it may also include the SLDS, RLDS or CA data sets if they exist at the remote site. The standard IMS Recovery Utility (DFSURDB0) or the IMS Database Recovery Facility (DRF) can be used to recover the database data sets.

Recover DBs to Last Good Log



- Remote: Restart Options
 - Cold Start IMS
 - *Batch Backout needed for Inflight UOWs*
 - Emergency Restart IMS
 - *Dynamic Backout handles inflight UOWs*
 - *Ensure IMS subsystem records still exist*
 - *Delete the PRIOLD/SECOLD records*
 - *IMS dynamically allocates SLDS records*
 - */ERE FORMAT WA RS*

If the IMS subsystem is to be Cold Started and Full Database Recovery was used to restore the database data sets, then the Batch Backout (BBO) Utility (DFSBBO00) is needed to backout any inflight UOWs at the end of the log data set. After Batch Backout is done, IMS can be restarted with a Cold Start or an Emergency Restart with the COLDSYS or COLDBASE option.

If the IMS subsystem is Emergency Restarted, checkpoint information is pulled from the SLDS data sets since the OLDS and RDS data sets were not sent to the remote site. In order to do this, some further cleaning is required on the RECON data set. The PRIOLD and SECOLD records must be deleted from the Backup RECON data set. The following DBRC commands can be used to do this:

```
DELETE.LOG OLDS(oldsname) SSID(ssidname)
```

```
DELETE.LOG OLDS(oldsname) SSID(ssidname) LASTCLOS
```

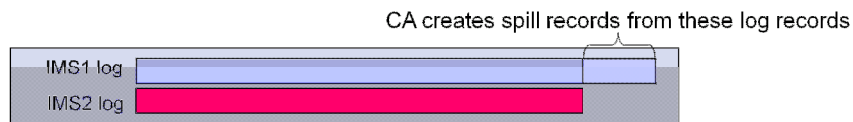
The first DELETE.LOG deletes all of the PRIOLD and SECOLD records except the last one. The second DELETE.LOG deletes the last PRIOLD and SECOLD record. Once the PRIOLD and SECOLD records are deleted in the DBRC RECON data set, IMS will dynamically allocate the last SLDS data set for restart.

The /ERE FORMAT RS WA formats the RDS and WADS data sets which were not sent to the remote site. During Emergency Restart, IMS dynamically backs out any inflight UOWs that were applied to the database data sets so that Batch Backout is not required to be run.

Recover DBs to Last Good Log



- IMS Datasharing Environments
 - Full Database Recoveries cannot be done
 - Recovery Points are needed
 - Logs from different systems have different end times
 - CA creates 'spill records' when one log extends past others



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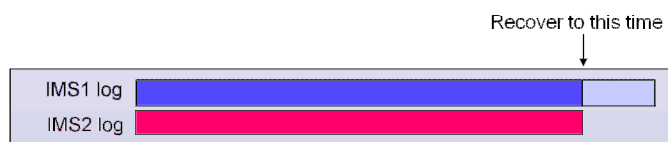
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Recover DBs to Last Good Log



- IMS Datasharing Environments
 - Timestamp recoveries with DRF
 - Does not require Recovery Point
 - May be done with fuzzy image copies
 - Benefits from parallel processing
 - Point-In-Time Recovery
 - Done to any time for which all logs are available at remote site



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19

If the IMS subsystem is to be Cold Started and Full Database Recovery was used to restore the database data sets, then the Batch Backout (BBO) Utility (DFSBB00) is needed to backout any inflight UOWs at the end of the log data set. After Batch Backout is done, IMS can be restarted with a Cold Start or an Emergency Restart with the COLDSYS or COLDBASE option.

If the IMS subsystem is Emergency Restarted, checkpoint information is pulled from the SLDS data sets since the OLDS and RDS data sets were not sent to the remote site. In order to do this, some further cleaning is required on the RECON data set. The PRIOLD and SECOLD records must be deleted from the Backup RECON data set. The following DBRC commands can be used to do this:

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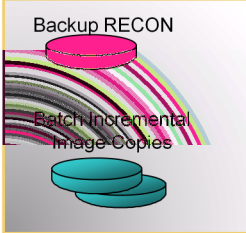
Timestamp Recovery to RP (IBM IMS Tools)

Primary Site

- (1) Start IMS
- (2) Create RPs with IMS V11 DB QUIESCE
- (3) Create Batch Incremental ICs to RP with DRF
- (4) Backup RECON and Clean to RP with IMS DRF/XF

Remote Site

- (1) Restore DBs using Batch ICs only to RP with DRF
- (2) Rebuild Pri/Sec Indexes, HALDB ILE with Index Builder
- (3) Cold Start IMS



Backup RECON
Batch Incremental Image Copies

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The disaster recovery strategy involving the IBM IMS Tools products uses Timestamp Recovery to a recovery point generated by the IMS DRF/XF product. With this solution, batch image copies are taken using High Performance Image Copy at the primary site and later updated using the Database Recovery Facility Incremental Image Copy process. The Incremental image copy is a batch image copy when it is created using logs up to a recovery point. The IMS DRF/XF tool cleans the RECON data set and prepares it for use at the remote site. The High Performance Pointer Checker tool is used each time an image copy is created or a database is recovered. The Index Builder tool rebuilds both the Full Function and HALDB primary and secondary indexes. Many of the reports created by these tools are deposited in the IMS Tools Knowledge Base repository.

New IMS Tools Solution Packs



IMS Database Solution Pack



- IMS Database Reorganization Expert
- IMS High Performance Unload
- IMS High Performance Load
- IMS High Performance Prefix Resolution
- IMS Index Builder
- IMS High Performance Pointer Checker
- IMS High Performance Image Copy
- IMS Library Integrity Utilities

IMS Performance Solution Pack



- IMS Connect Extensions
- IMS Performance Analyzer
- IMS Problem Investigator

IMS Recovery Solution Pack



- IMS Database Recovery Facility
- IMS Database Recovery Facility XF
- IMS Index Builder
- IMS High Performance Change Accumulation
- IMS High Performance Image Copy

IMS Fast Path Solution Pack



- IMS Fast Path Advanced Tools
- IMS Fast Path Basic Tools
- IMS Fast Path Online Tools
- IMS Library Integrity Utilities
- IMS High Performance Image Copy
- IMS Database Repair Facility

IMS Tools Base (No Charge Pack)



- IMS Tools Knowledge Base
- IMS Tools Generic Exits
- Policy Services
- Distributed Access Infrastructure
- IMS Hardware Data Compression Extended

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IBM IMS Tools



- **IMS Database Recovery Facility (DRF) (5655-V86)**
 - All databases are recovered in one pass of the logs
 - Creates Image Copy, drives Pointer Checking during recovery
 - *IBM IMS High Performance Pointer Checker (5655-K53)*
 - *IBM IMS High Performance Image Copy (5655-N45)*
 - Invokes Index Builder to rebuild indexes and HALDB ILE
 - *IBM IMS Index Builder (5655-R01)*
 - **Incremental Image Copy**
 - Image Copy is updated with SLDS without /DBR command
 - Log data sets are not required at Remote Site
 - Produces batch image copies
 - Shorter recovery time
 - **Point-In-Time Recovery**
 - Recovery Point is not needed
 - Recovery is to any timestamp (only committed updates applied)

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22

There are six IBM IMS Tools used in this disaster recovery solution. The first tool, IMS Database Recovery Facility (DRF) invokes three of the other tools: 1) IBM IMS High Performance Image Copy, 2) IBM IMS High Performance Pointer Checker, and 3) IBM IMS Index Builder. IMS DRF restores databases and can also create an Incremental image copy. The DRF tool reads the logs in one pass no matter how many databases are being restored at one time.

IMS DRF can also recover a database and create an image copy and run pointer checker for each database in parallel. The IMS Index Builder tool is also invoked by DRF to rebuild full function and HALDB primary and secondary indexes and ILE data sets.

The IMS DRF tool also has the ability to do a Point-In-Time Recovery (PITR) to any timestamp even if it is not a Recovery Point in IMS. When PITR is performed, only committed updates are applied to the database.

IBM IMS Tools



- **IMS DRF Xtended Functions (5655-V86)**
 - Provides Disaster Recovery services
 - Copies and cleans RECON data set for remote site
 - Analyzes availability of recovery resources
- **IMS Tools Knowledge Base for z/OS (5655-V93)**
 - Report repository for IMS Tools
 - ISPF interface

There are six IBM IMS Tools used in this disaster recovery solution. The first tool, IMS Database Recovery Facility (DRF) invokes three of the other tools: 1) IBM IMS High Performance Image Copy, 2) IBM IMS High Performance Pointer Checker, and 3) IBM IMS Index Builder. IMS DRF restores databases and can also create an Incremental image copy. The DRF tool reads the logs in one pass no matter how many databases are being restored at one time.

IMS DRF can also recover a database and create an image copy and run pointer checker for each database in parallel. The IMS Index Builder tool is also invoked by DRF to rebuild full function and HALDB primary and secondary indexes and ILE data sets.

The IMS DRF tool also has the ability to do a Point-In-Time Recovery (PITR) to any timestamp even if it is not a Recovery Point in IMS. When PITR is performed, only committed updates are applied to the database.



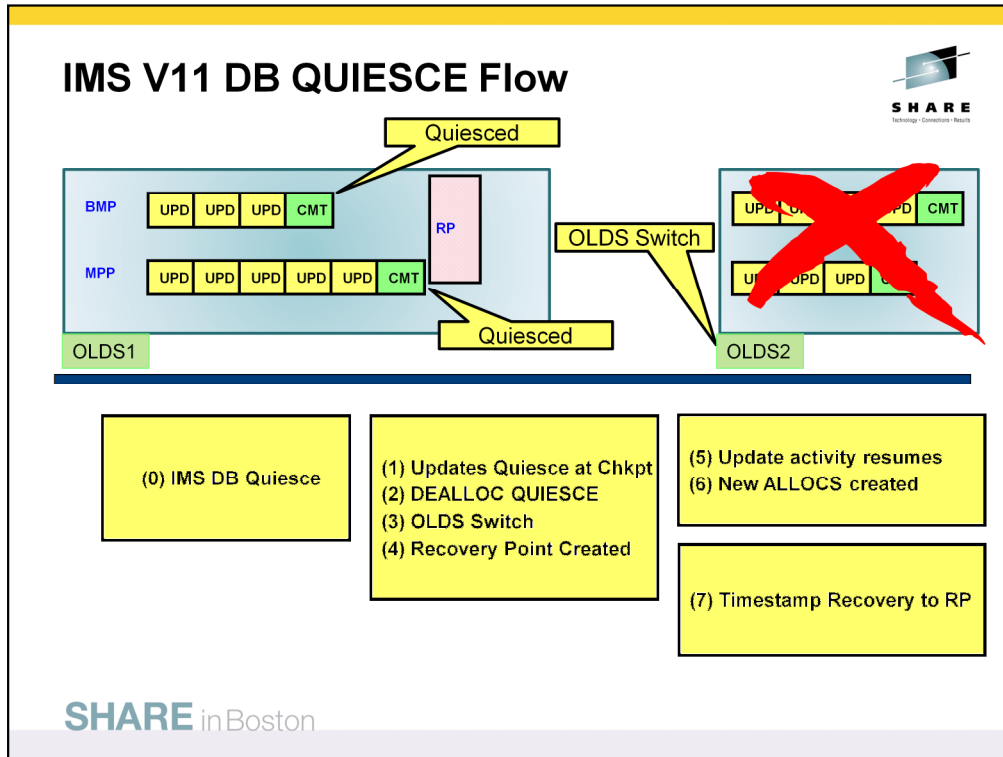
Timestamp Recovery to RP

- Prepare the Data for Remote Site
 - Create Recovery Point
 - Option (1) Take databases offline:
 - *UPDATE DB STOP(ACCESS) or /DBR*
 - *UPDATE DB STOP(UPDATES) or /DBD*
 - Option (2) BMP Pausing with IMS DRF/XF RPCR
 - Option (3) IMS V11 DB Quiesce Command
 - DRF Incremental Image Copy
 - Create Batch IC while databases are available to RP
 - IMS DRF/XF
 - Clean Backup Recon to RP
 - Ship Batch Incremental ICs, RECON Backup to Remote Site

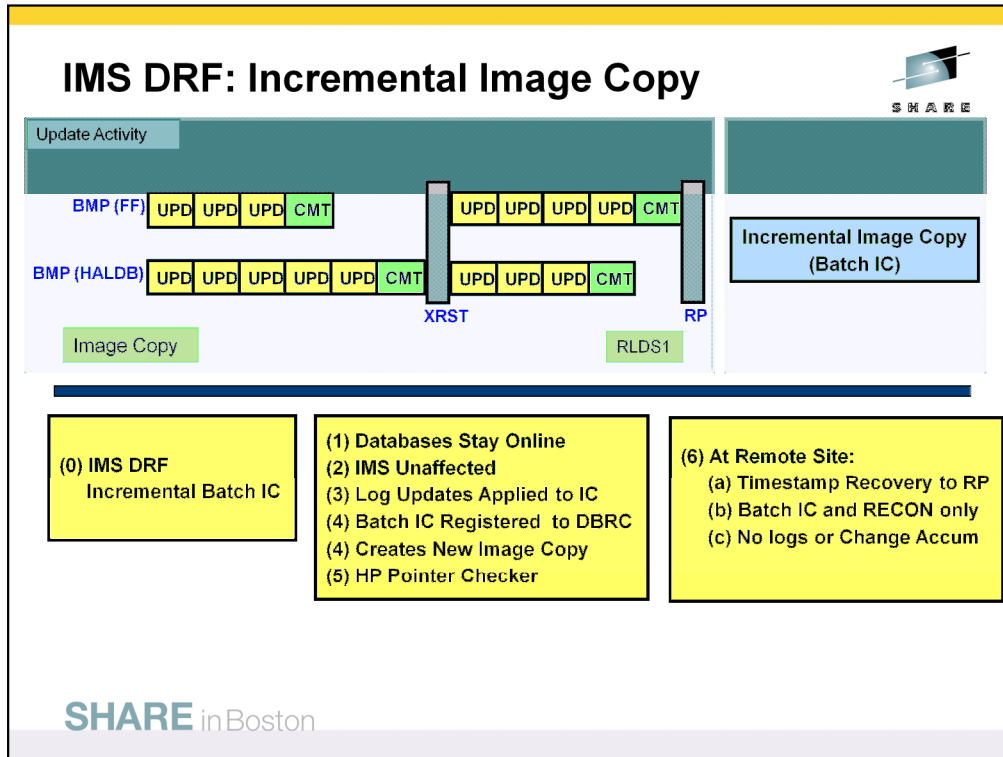
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In this disaster recovery solution which involves six IBM IMS Tools products, a timestamp recovery is performed at the remote site using only batch image copies and the backup DBRC RECON data set. In order to do a timestamp recovery, a recovery point is required. There are several ways to create recovery points. First, the databases can be made unavailable using the Type-2 commands: *UPDATE DB STOP(ACCESS)* or *UPDATE DB STOP(UPDATES)*. These are equivalent to the Type-1 commands: */DBR* or */DBD*. Second, the IMS DRF/XF function Recovery Point Create (RPCR) can be used which allows BMPs to be paused at checkpoints without taking the databases offline. And, third, in IMS 11, a new Type-2 command called *DB QUIESCE* can be used to pause transactional activity at checkpoints in the same way the BMP pausing code works with RPCR.

Once the Recovery Point is created, the IMS DRF tool can create a batch Incremental image copy using a previously created image copy and all of the archived logs up through the recovery point. The Incremental image copy is created with an offline utility while the databases are still available to IMS. IMS DRF/XF is also used to create a backup of the RECON data set and to clean it up to a specific timestamp. The timestamp used in this disaster recovery scenario is the same as the Recovery Point created by RPCR. Finally, the batch Incremental image copies and the clean backup of the RECON data set are shipped to the remote site.



The IMS V11 DB QUIESCE function allows BMPs and MPPs that access both Full Function and HALDB databases to pause at checkpoints once the command is issued. DBRC removes authorization to the database and the database remains open until authorization is restored. The OLDS are switched and a recovery point is created. The transactions resume activity following the checkpoint. The recovery point creates DEALLOCS for the databases involved in the command. Transactions that are not doing any update activity are unaffected by the DB QUIESCE command.



The Incremental image copy is created using the IMS DRF tool along with the IMS High Performance Image Copy tool. An Incremental image copy is created offline using a form of timestamp recovery with OUTPUT(ICR) specified on the recovery command. The Incremental image copy is itself a new image copy; it is not a update to an earlier image copy. In other words, the Incremental image copy can be used in a recovery without any prior image copies.

If the Incremental image copy is created using image copies and logs up through a recovery point, then it is flagged as a batch image copy in the DBRC RECON data set. If the Incremental image copy is created using logs but not to a recovery point, then it is flagged as a CONCUR image copy in the DBRC RECON data set.



IMS DRF/XF: RECON Cleanup

- IMS DRF/XF (RECONCOPY)
 - Makes a copy of the Production RECON data set

- IMS DRF/XF (RCU)
 - Cleanup RECON using RP Timestamp
 - Closes open PRILOG, PRIOLD and SECSLD records
 - Deletes PRIOLD, SECOLD and SUBSYS records
 - Updates or deletes ALLOC and LOGALL records
 - Deletes IC and CA records past the Timestamp provided
 - Flags primary image copies as INVALID if dual used
 - Makes RECON ready for Remote Site
 - No manual user operations necessary

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The IMS DRF/XF Recon Clean Up (RCU) function allows the Recon to be cleaned up prior to shipping to the Remote Site. It could also be cleaned up at the Remote Site. The RCU function takes a timestamp as input and essentially updates the Backup Recon to appear as if time stopped after this timestamp. In the disaster recovery case, the timestamp could be the Recovery Point created by the RPCR function.

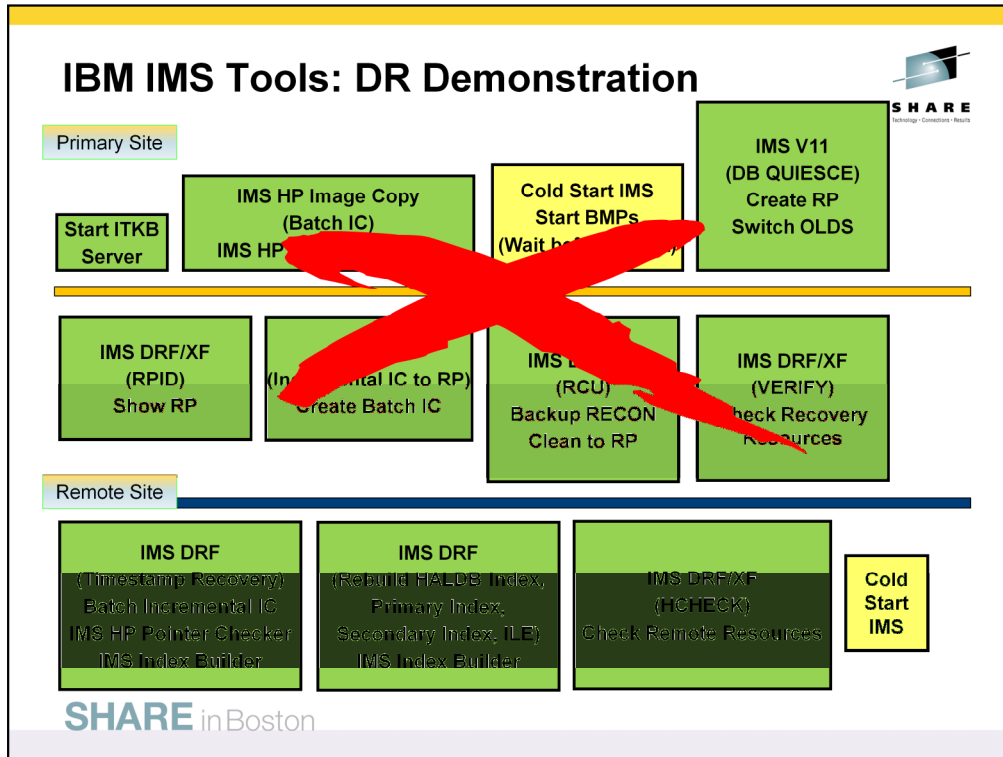


Remote Site: Timestamp Recovery to RP

- Restore Databases to RP and Cold Start
 - RECON was cleaned at the Primary Site to RP
 - Restore databases to RP using Timestamp Recovery
 - IMS Database Recovery Facility (DRF) restores databases
 - Uses only Batch Incremental Image Copies
 - Creates new image copies with IMS HP Image Copy
 - Runs IMS HP Pointer Checker at same time
 - IMS Index Builder rebuilds Primary/Secondary Index, HALDB ILE
 - Indexes are rebuilt (not recovered)
 - Cold Start IMS

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In this disaster recovery scenario using six IBM IMS Tools products, most of the work is done at the primary site. For instance, the DBRC RECON data set is copied and cleaned up at the primary site and it can be immediately used at the remote site. The only steps necessary at the remote site are the recoveries of the database data sets. These recoveries use only the batch Incremental image copies and the RECON data set. During recovery, the IMS High Performance Image Copy tool and IMS High Performance Pointer Checker tool can be used while the databases are recovered in parallel. Following the recovery of the database data sets, the IMS Index Builder tool rebuilds the Primary and Secondary indexes and the HALDB ILE data set. Since the IMS SSYS records were deleted with the cleanup of the RECON data set, an IMS Cold Start is required at the remote site.



The following demonstration will show how the six IBM IMS Tools products can work together to provide a very good disaster recovery solution. First, the IMS High Performance Image Copy tool will create an initial batch image copy with IMS High Performance Pointer Checking verifying the pointers while the image copy is created.

After IMS is cold started, an IMS V11 DB QUIESCE command will be issued to create a Recovery Point without taking any databases offline. This recovery point will be used for a timestamp recovery at the remote site. The IMS DRF/XF function Recovery Point Identification (RPID) will show the recovery point created by RPCR.

Using the recovery point created by RPCR, a batch Incremental image copy will be created using IMS Database Recovery Facility (DRF) and IMS High Performance Image Copy. The IMS Recovery Expert tool will create a backup of the RECON data set using RECONCOPY and it will also clean it up for the remote site using the Recon Cleanup (RCU) function. Finally, the IMS Recovery Expert function VERIFY will check the availability of the data sets that will be used at the remote site.

At the remote site, the IMS DRF tool will use timestamp recovery (TSR) using the batch Incremental image copies to restore the database data sets to the recovery point created by RPCR at the primary site. The IMS High Performance Image Copy and IMS High Performance Pointer Checker tools will also be executed during the recovery. The IMS Index Builder tool will rebuild all of the primary and secondary indexes as well as the HALDB ILE data set.

Finally, IMS is cold started.

Demonstration of IBM IMS Tools Disaster Recovery

Demonstration of IBM IMS Tools Disaster Recovery Solution.